Appendix C

Rectification

The rectification procedure discussed in Section 2.3.3 approaches the rectification prob-
lem from the perspective of camera rotations about the optical centers of the cameras. This
rotation must align the optical axes (i.e., make them parallel) and mutually perpendicular
to the baseline (i.e., 3D line) connecting the camera centers. By itself, this process leaves
the direction of the optical axes under-constrained, free to rotate in the plane whose sur-
face normal is given by the baseline. In order to constrain this degree of freedom, we
require that the rectified optical axes have minimum deviation from the average of the two
unrectified optical axes. To implement this strategy, we compute the average direction of
the two input optical axes, and then remove the portion of that direction that lies along the
computed baseline. This difference is orthogonal to the baseline and minimally different
from the average direction. The rectification procedure is then given below. The camera
centers are assumed to be specified in the world coordinates, as all vectors are 3D vectors
in the world coordinate system.

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Algorithm: Rectify Camera Pair

$\overline{\text{baseline}} = \overline{\text{camcenter1}} - \overline{\text{camcenter2}};$
$\overline{\text{Xaxis}} = \text{normalize}(\overline{\text{baseline}});$

$\overline{\text{avgZaxis}} = \text{normalize}(\overline{\text{Zaxis1}} + \overline{\text{Zaxis2}});$
$\text{coef} = \overline{\text{Xaxis}} \cdot \overline{\text{avgZaxis}};$
$\overline{\text{tmpaxis}} = \overline{\text{avgZaxis}} - (\text{coef} * \overline{\text{Xaxis}});$
$\overline{\text{Zaxis}} = \text{normalize}(\overline{\text{tmpaxis}});$

$\overline{\text{tmpaxis}} = \overline{\text{Zaxis}} \times \overline{\text{Xaxis}};$
$\overline{\text{Yaxis}} = \text{normalize}(\overline{\text{tmpaxis}});$

$$R = \begin{bmatrix} Xaxis(1) & Xaxis(2) & Xaxis(3) \\ Yaxis(1) & Yaxis(2) & Yaxis(3) \\ Zaxis(1) & Zaxis(2) & Zaxis(3) \end{bmatrix}$$

$\overline{\text{translation1}} = -R \cdot \overline{\text{camcenter1}};$
$\overline{\text{translation2}} = -R \cdot \overline{\text{camcenter2}};$

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